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ORIGINAL RESEARCH

Prevalence and Impact of type 2 Diabetes Mellitus on the Severity of Chronic Obstructive PulmonaryDisease

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Abstract

Introduction: Diabetes mellitus (DM) is an important and common comorbid condition associated with chronic obstructive pulmonary disease (COPD). The exact prevalence of DM in COPD patients among the Indian population is unknown. Coexisting DM is associated with poor outcome in COPD patients and has a significant impact on lung function and severity of the disease. The aim of this study was to determine the prevalence of type 2 DM in COPD patients attending tertiary care hospital and to assess its impact on the severity of the disease and exacerbation.

Materials and methods: A cross-sectional study was done at Department of Respiratory Medicine, SPMC, Bikaner. 100 patients of COPD with or without DM were included. An interview schedule consisting of sociodemographic details and GOLD criteria 2021 to diagnose COPD and the WHO criteria for DM was used. Unpaired t test was applied to determine significance.

Results: Prevalence of DM was 29.0% (29) among 100 COPD patients studied. Prevalence of mild, moderate, severe, and very severe COPD among DM group was 13.79%, 20.68%, 34.48%, and 31.03%, respectively. DM group patients had a significant decline in lung function compared to non-DM group (mean FEV1% 45.37±20.60 v/s 63.12±23.86, ($P < 0.05$), and majority of patients with DM (38%) were in exacerbation compared to non-DM group (27%).

Conclusion: The prevalence of DM is high in COPD patients. Patients with poor glycemiccontrol have more severe COPD, poor lung function, increased risk of exacerbations. So it is crucial to screen all COPD patients for DM routinely and DM patients must undergo periodic spirometry to assess the severity of lung function impairment.

Introduction

Global Initiative for Chronic Obstructive Lung Disease (GOLD) defines that Chronic Obstructive Pulmonary Disease (COPD) is a common, preventable and treatable disease that is characterized by persistent respiratory symptoms and airflow limitation that is due to airway and/or alveolar abnormalities usually caused by significant exposure to noxious particles or gases and influenced by host factors including abnormal lung development.[1]

In developed countries, cigarette smoking is the main etiologic factor, outweighing any of the other risk factors. However, in developing countries, the major cause is exposure to biomass fuels. The pathogenesis of COPD is strongly linked to the effects of cigarette smoke on the

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lungs. There is a general relationship between the extent of the smoking history and the severity of the airflow limitation; however, there is a huge individual variation.[2]

Fletcher and colleagues,[3] in an 8-year prospective study of working men in west London, showed that the average decline in FEV1 in smokers is faster (60 mL/year) than in nonsmokers (30 mL/year). However, smokers who develop COPD have an average decline in FEV1 of greater than 60 mL/year, although only a proportion of smokers develop clinically significant COPD. It is from these studies that the concept of the "susceptible smoker" developed.

It is important to recognize that chronic respiratory symptoms may precede the development of airflow limitation and may be associated with the development of acute respiratory events.[4] Chronic respiratory symptoms also exist in individuals with normal spirometryand a significant number of smokers without airflow limitation have structural evidence of lung disease manifested by the varying presence of emphysema, airway wall thickening and gas trapping.[5,6]

COPD should be considered in any patient who has dyspnea, chronic cough or sputum production, and/or a history of exposure to risk factors for the disease.

Spirometry is required to make the diagnosis in this clinical context[7]; the presence of a post-bronchodilator FEV1/FVC < 0.70 confirms the presence of persistent airflow limitation and thus of COPD in patients with appropriate symptoms and significant exposures to noxious stimuli.

Chronic Obstructive Pulmonary Disease (COPD) is now one of the top three causes of death worldwide and 90% of these deaths occur in low- and middle-income countries (LMICs).[8] More than 3 million people died of COPD in 2012 accounting for 6% of all deaths globally. Globally, the COPD burden is projected to increase in coming decades because of continued exposure to COPD risk factors and aging of the population.[9]

Based on the Burden of Obstructive Lung Diseases (BOLD) program and other large scale epidemiological studies, it is estimated that the number of COPD cases was 384 million in 2010, with a global prevalence of 11.7% (95% confidence interval (CI) 8.4%–15.0%).[10] Globally, there are around three million deaths annually.[11] With the increasing prevalence of smoking in developing countries, and aging populations in high-income countries, the prevalence of COPD is expected to rise over the next 40 years and by 2060 there may be over 5.4 million deaths annually from COPD and related conditions.[12]

Common comorbidities associated with COPD are diabetes mellitus (DM), systemic hypertension, ischemic heart disease, and heart failure. Among these, DM is one of the frequent comorbidities encountered in patients with COPD which can significantly alter the course of the disease.[13,14]

COPD and DM, both being pro-inflammatory conditions, they share relevant features in their etiology and course. COPD patients are more prone to develop type 2 DM due to multiple risk factors such as obesity, sedentary lifestyle, smoking, increased inflammation, oxidative stress, and corticosteroid therapy. The prevalence of DM in COPD patients is 2%–37% depending on the patient population studied and is consistently associated with a 1.4–2.0 fold increased risk of developing DM.[15]

COPD patients have a relatively increased risk of developing diabetes mellitus DM and diabetic patients have an increased risk of developing COPD. This side by side development of both diseases is a result of common risk factor like smoking and also synergistic effect of systemic inflammation mediated by common cytokines. Metabolic syndrome, insulin resistance and systemic inflammation constitute risk factors for decreased lung function in healthy non smoking subjects which suggest that even in the absence of smoking DM can lead to similar effects on pulmonary function.

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Hyperglycemia has the potential to impact the respiratory system by inducing oxidative stress, hypoxemia, systemic inflammation, structural changes in the lung tissue and altered gas exchange.[16,17]

Decrements in the lung function of patients with DM are believed to be the consequence of biochemical alterations in the connective tissue constituents of the lung particularly elastin and collagen as well as microangiopathy due to the non enzymatic glycosylation of proteins and of the extra cellular matrix or lung parenchyma, thickening of basal lamina, increased susceptibility to infection and a modified sarcolemma with subsequent skeletal muscle weakness which are induced by chronic hypoglycemia. Diabetic microangiopathy itself alters the alveolar diffusion capacity of the lungs [18-24] and autonomic neuropathy may affect phrenic nerves resulting in reduced muscle tone and control of the diaphragm.

Considering the enormously growing incidence of both DM and COPD in India, the convergence of these two chronic NCDs poses a great challenge to the treating physician. Hence, this study has been taken up, to know the prevalence of DM in COPD patients attending our tertiary care center and to know its impact on the lung function and severity of the COPD.

Aims and objectives

- To determine the prevalence of type 2 DM in COPD patients attending tertiary care hospital.
- To assess the impact of type 2 DM on the severity of the disease and exacerbation.

Material and method

The study was conducted on patients attending Department Of Respiratory Medicine, Sardar Patel Medical College, Bikaner, Rajasthan.

Study Design

It was a hospital based cross-sectional Study.

Source of Data

Patients admitted in Respiratory Disease Hospital, Bikaner.

Sampling method

Consecutive sampling.

Study Period

For one year (Jan. 2021 to Dec. 2021).

Sample Size

We have included 100 cases of COPD patient with or without type 2 DM attending Respiratory Disease Hospital, Bikaner.

The study included diagnosed patients of Chronic Obstructive Pulmonary disease, with or without type 2 DM, irrespective of severity and duration of the disease. Study cases were personally interviewed to get relevant details after getting informed signed consent. Based upon inclusion and exclusion criteria a minimum of 100 cases were selected

Inclusion criteria

1. Those who are giving informed consent.
2. Patients aged more than 40 years and less than 80 years.

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3. Patients already on treatment for COPD by a chest physician or newly diagnosed COPD patients based on post bronchodilator FEV1/FVC < 0.7 on spirometry without DM or with DM already on treatment or newly detected patients.

Exclusion criteria

1. Hemodynamically unstable patients.
2. Patients having history of Coronary artery disease, decompensated cardiac disease, Stroke and significant hemorrhage in last 6 months.
3. Those having a history of bronchial asthma, interstitial lung disease, concomitant lung cancer, present or past history of tuberculosis.
4. Patients not willing to participate in the study

Results

Table No.-1 Prevalence of DM in study subjects

S. No.	Total COPD patients	COPD without DM	COPD with DM
1.	100	71	29

Tables shows, majority (71%) of patients in COPD without DM group followed by (29%) patients in COPD with DM group. So prevalence of DM among COPD patients is 29%.

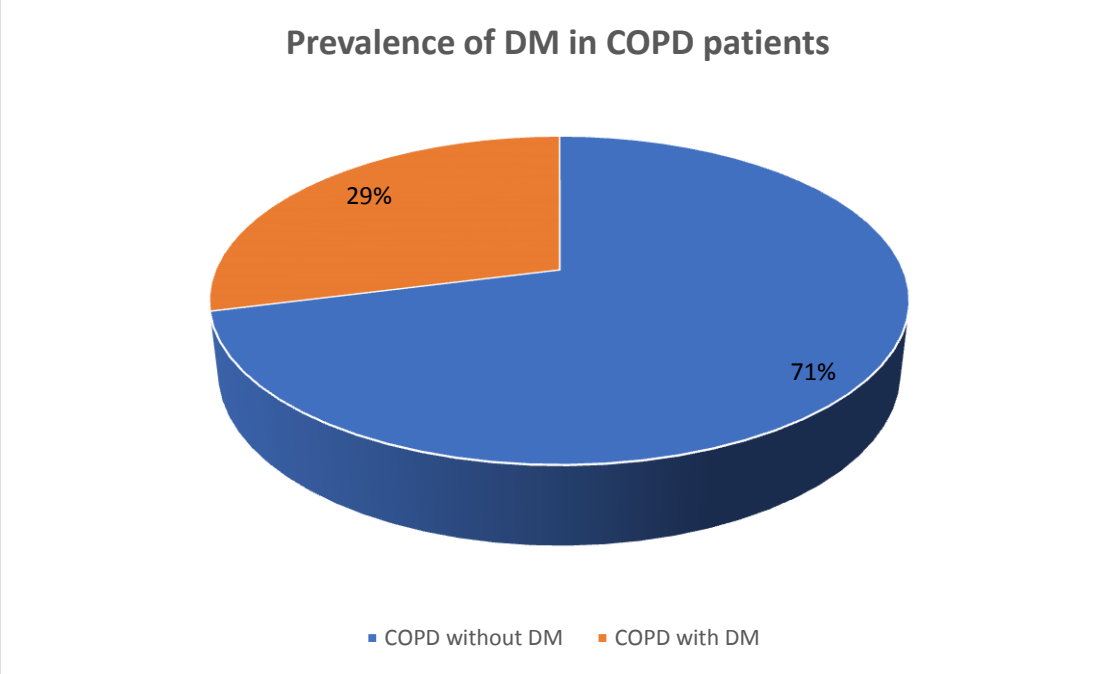

Table No.-2 Age wise distribution of study subjects

S. No.	Age in years	COPD without DM	COPD with DM
1.	41-50	5 (7%)	1 (3%)
2.	51-60	16 (23%)	4 (15%)
3.	61-70	33 (46%)	14 (48%)
4.	71-80	17 ((24%)	10 (34%)
	Total	71	29
	Mean Age	64.94±8.38	68.37±6.93

Table shows, majority of the patients (46%) and (48%) in the age group 61-70 years in both

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groups followed by (24%) and (34%) in the age group of 71-80 years.

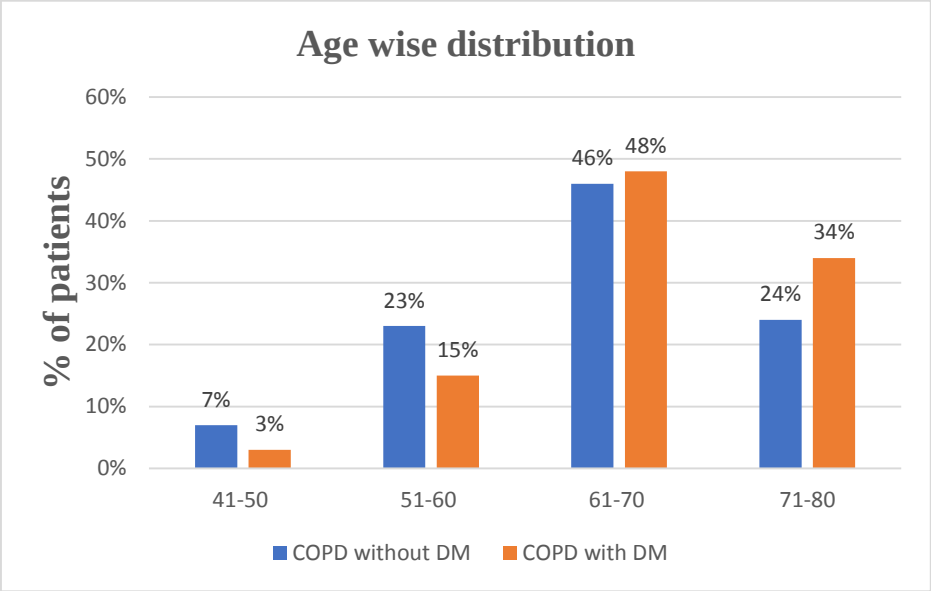

Table No.-3 Sex wise distribution of study subjects

S. No.	Sex	COPD without DM	COPD with DM
1.	Male	52 (73%)	20 (69%)
2.	Female	19 (27%)	9 (31%)
	Total	71	29

Table shows, sex wise distribution of study subjects. It is a male dominant study with 52 (73%) male cases in COPD without DM group followed by 20 (69%) cases in COPD with DM group.

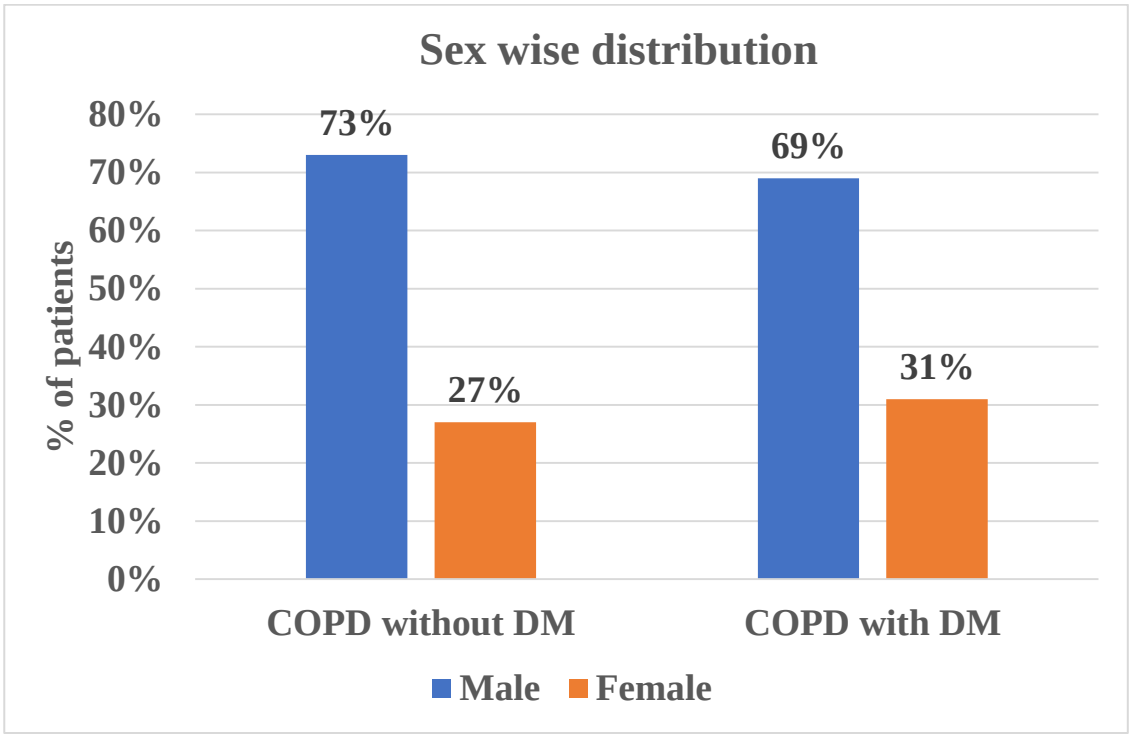

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Table No.-4 Socio-economic status wise distribution of study subjects

S. No.	Socio-economic status	COPD without DM	COPD with DM
1.	Upper	1 (1.4%)	7 (24%)
2.	Middle	22 (31%)	7 (24%)
3.	Lower	48 (67.6%)	15 (52%)

Table shows, Socio-economic status wise distribution of study subjects with the majority of cases, 48 (67.6%) in COPD without DM group and 15 cases (52%) in COPD with DM group in Lower socio-economic status group followed by Middle economic group 22 cases (31%) in COPD without DM group and 7 cases (24%) found in COPD with DM group. 1 case (1.4%) in COPD without DM group and 7 cases (24%) in COPD with DM group found in Upper socio-economic group.

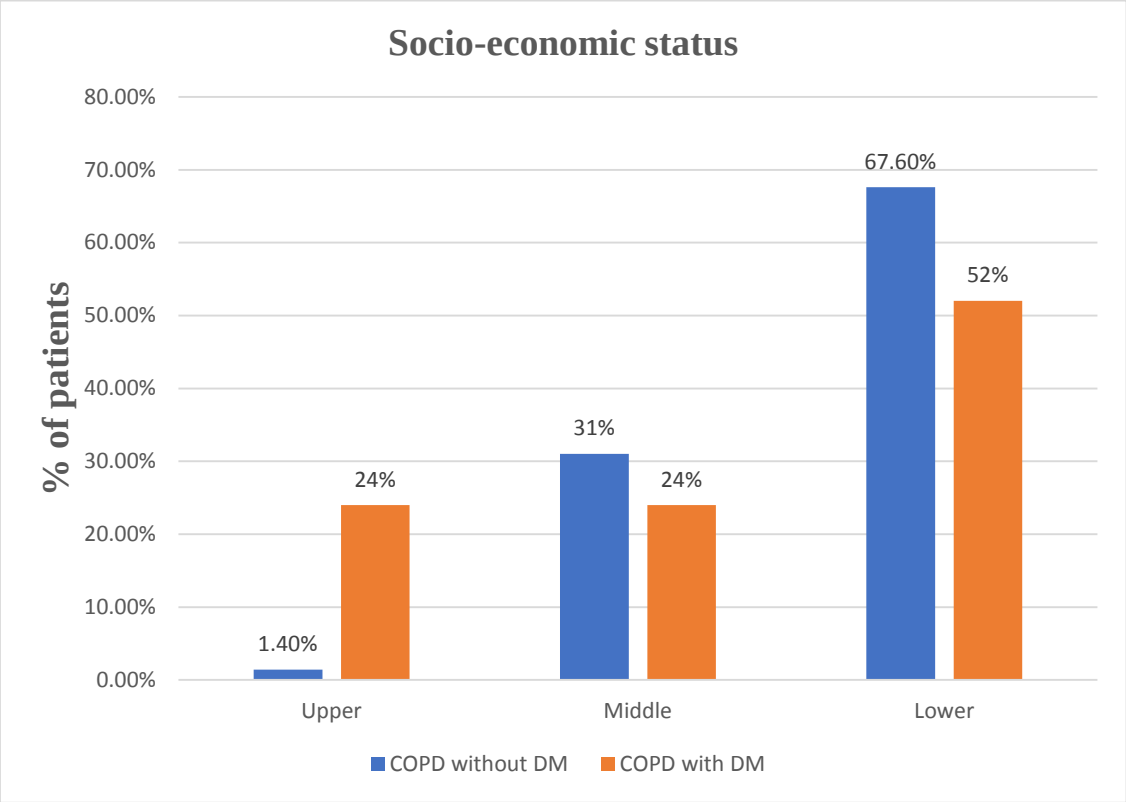

Table No.-5 BMI wise distribution of study subjects

S. No.	BMI in kg/m^2	COPD without DM	COPD with DM
1.	Mean	22.47	22.96
2.	SD	2.62	2.80

Table shows BMI wise distribution of study subjects. Mean ± SD (22.47±2.62) kg/m^2 in COPD without DM group and (22.96±2.80) kg/m^2 in COPD with DM group.

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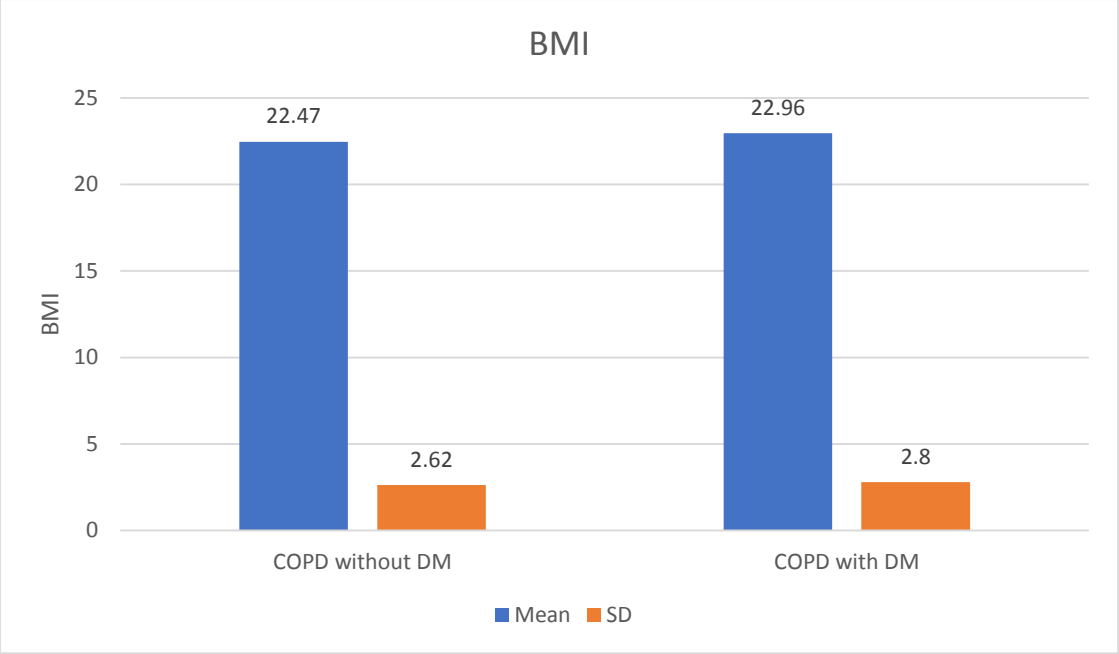

Table No.-6 Smoking status wise distribution of study subjects

S. No.	Smoking	COPD without DM	COPD with DM
1.	Smoker	27 (38%)	9 (31%)
2.	Ex-smoker	28 (39%)	14 (48%)
3.	Non-smoker	16 (23%)	6 (21%)

Table shows, Smoking habits of study subjects with the majority of Ex-Smokers 28 cases (39%) found in COPD without DM group, 14 cases (48%) found in COPD with DM group. In current smoker category, 27 cases (38%) in COPD without DM group and 9 cases (31%) found in COPD with DM group. 16 cases (23%) in COPD without DM and 6 cases (21%) in COPD with DM group found in Non-smoking category.

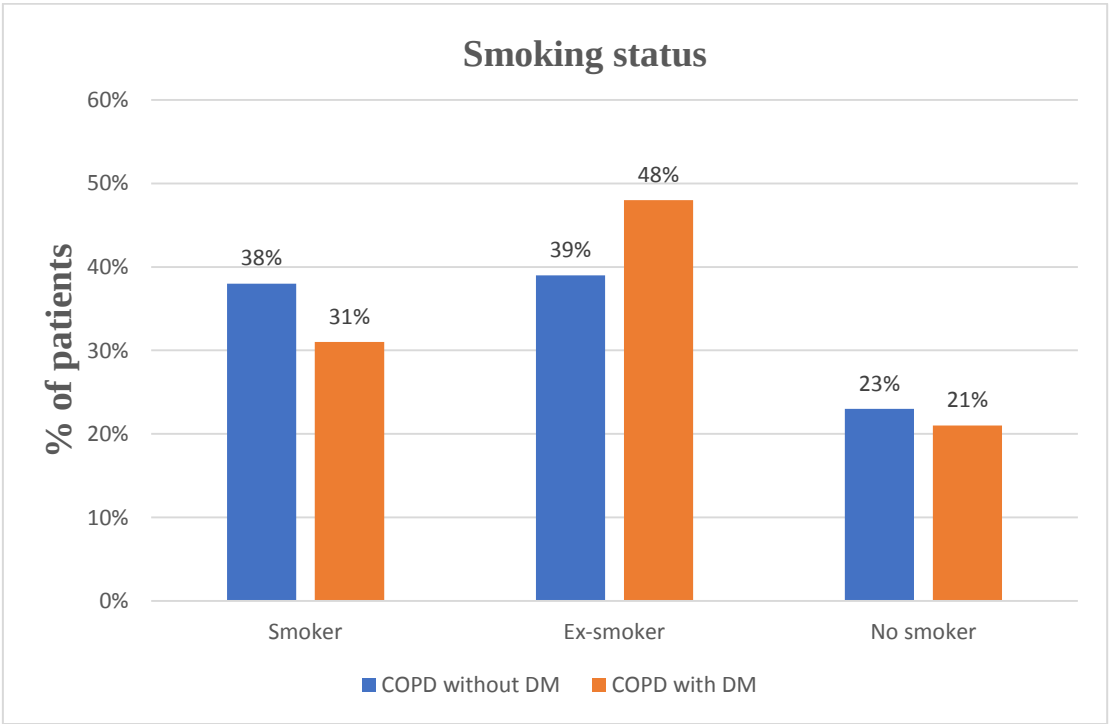

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Table No.-7 Pack year wise distribution of study subjects

S. No.	Pack year	COPD without DM	COPD with DM
1.	0 pack year (No smoker)	16 (23%)	6 (21%)
2.	1-10 pack year	1 (1.4%)	0
3.	11-20 pack year	14 (20%)	3 (10%)
4.	21-30 pack year	19 (26%)	9 (31%)
5.	>30 pack year	21 (29.6%)	11 (38%)
	Total	**71**	**29**
	Mean pack year	27.81±7.69	29.13±6.75

Table shows, majority of patients (29.6%) in COPD without DM group and 38% in COPD with DM group are in >30 pack year category followed by 26% and 31% respectively in 21-30 pack year category.

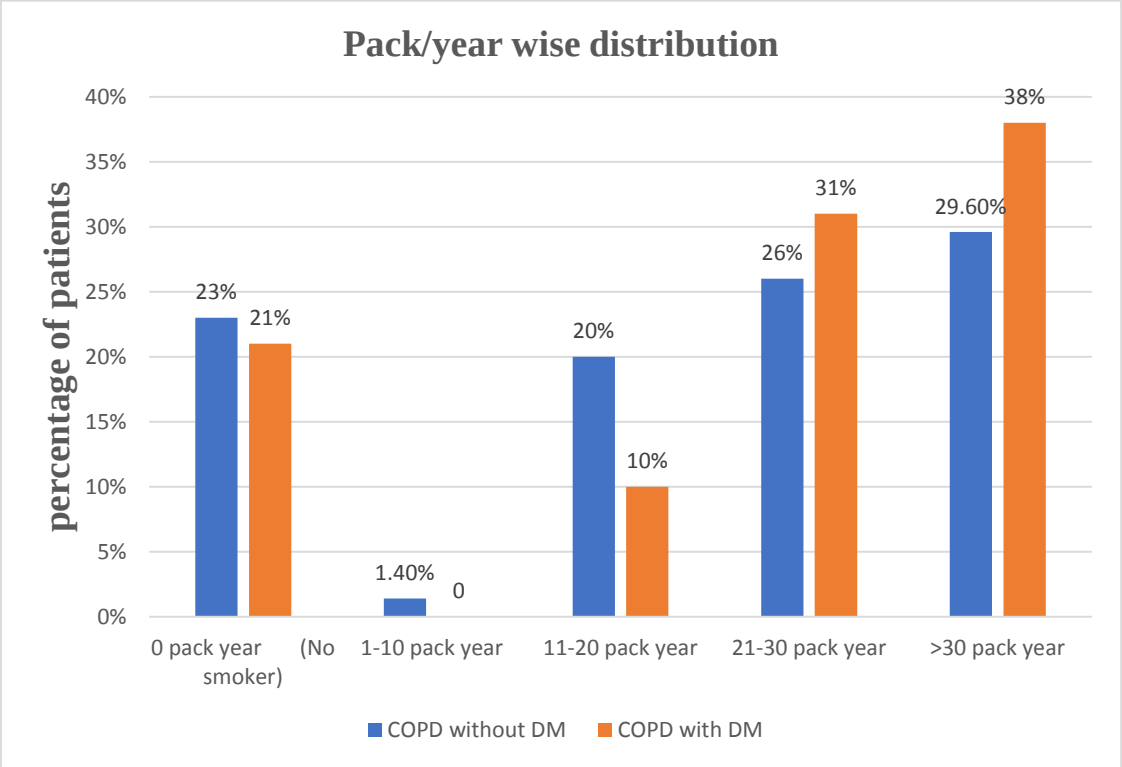

Table No.-8 Biomass fuel exposure year wise distribution of study subjects

S. No.	Biomass fuel exposure year	COPD without DM	COPD with DM
1.	0-10 year	0	0
2.	11-20 year	7	3
3.	21-30 year	6	2
4.	>30 year	1	1
	Total	**14**	**6**
	Mean year	25.00±5.54	27.00±4.47

Table shows, Biomass fuel exposure year wise distribution of study subjects with the Mean ± SD (25.00±5.54) in COPD without DM group and (27.00±4.47) in COPD with DM group. These are mostly female patients.

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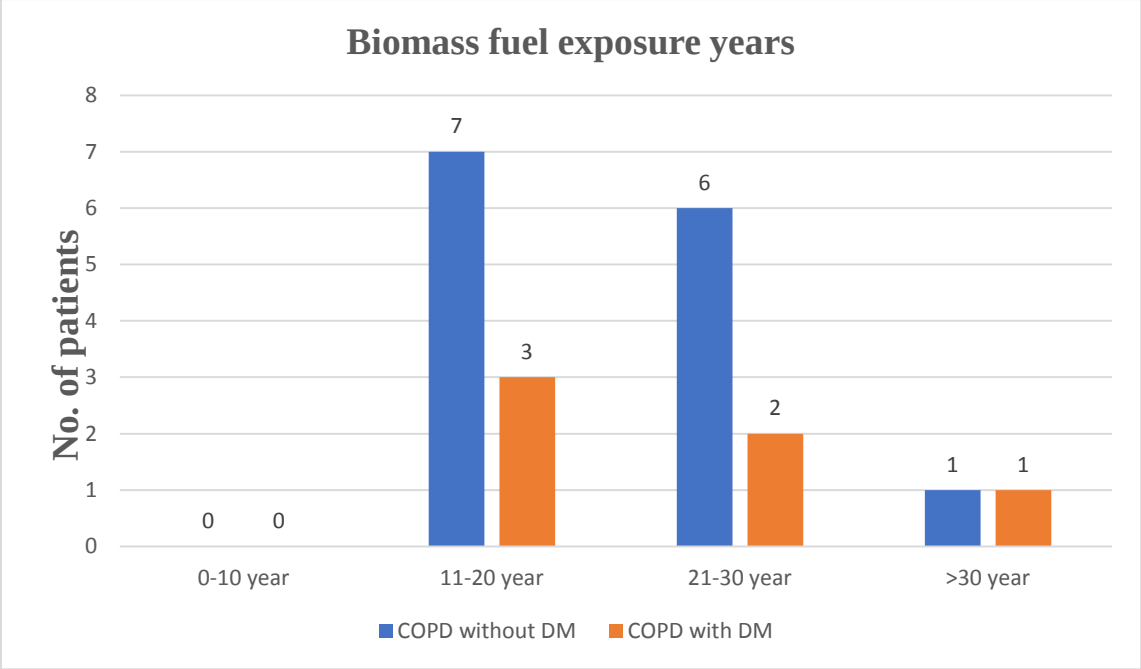

Table No.-9 Symptoms wise distribution of study subjects

S.No.	Symptoms	COPD without DM	COPD with DM
1.	Breathlessness	71	29
2.	Cough	68	27
3.	Expectoration	46	17
4.	Wheezing	64	26
5.	Chest pain	27	13

Tables shows, Symptoms wise distribution of study subjects. 71 subjects (Out of 71) in COPD without DM group and 29 subjects (Out of 29) in COPD with DM group presented with Breathlessness. 68 subjects (Out of 71) in COPD without DM group and 27 subjects (Out of 29) in COPD with DM presented with cough. Expectoration was present in 46 (Out of 71) and 17 (Out of 29). Wheezing was found in 64 (Out of 71) and 26 (Out of 29) subjects in both groups followed by Chest pain found in 27 (Out of 71) and 13 (Out of 29) patients in the both groups respectively.

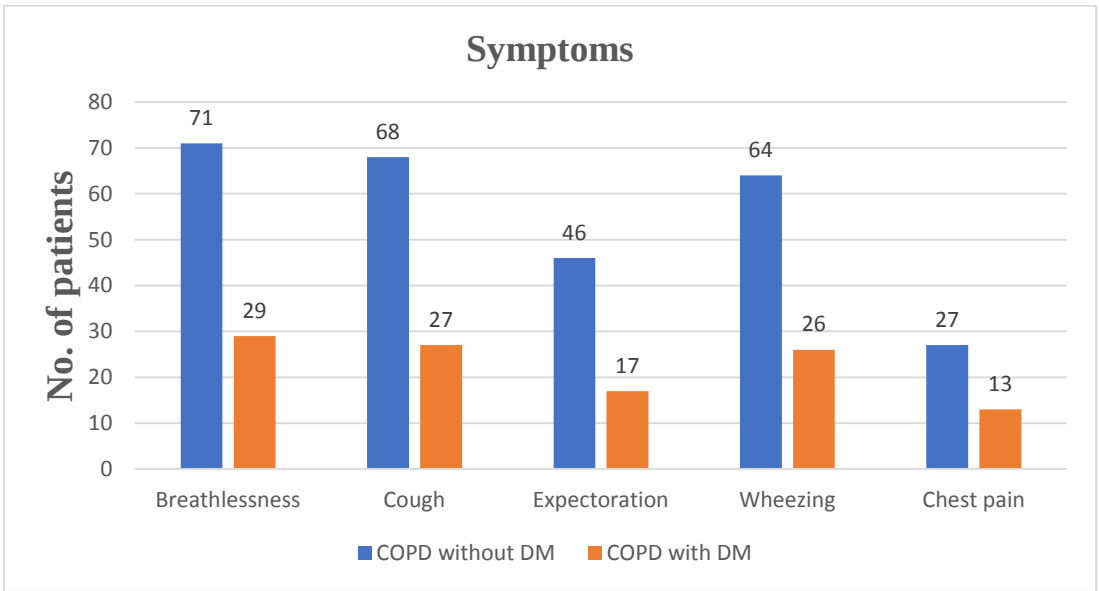

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Table No.-10 Blood glucose level wise distribution of study subjects

S. No.	Blood glucose	COPD without DM (Mean ± SD)	COPD with DM (Mean ± SD)
1.	Random	100.04 ± 20.21	231.51±56.10
2.	Fasting	84.31 ± 11.37	132.68 ± 5.61
3.	Postprandial	133.19 ± 6.35	217.0 ± 13.92

Table shows, Blood glucose level wise distribution of study subjects. Mean ± SD of both groups in Random blood glucose were (100.04±20.21) and (231.51±56.10). Mean ± SD of both groups in Fasting blood glucose were (84.31±11.37) and (132.68±5.61. Mean ± SD of postprandial blood glucose (133.19 ± 6.35) and (217.0 ± 13.92).

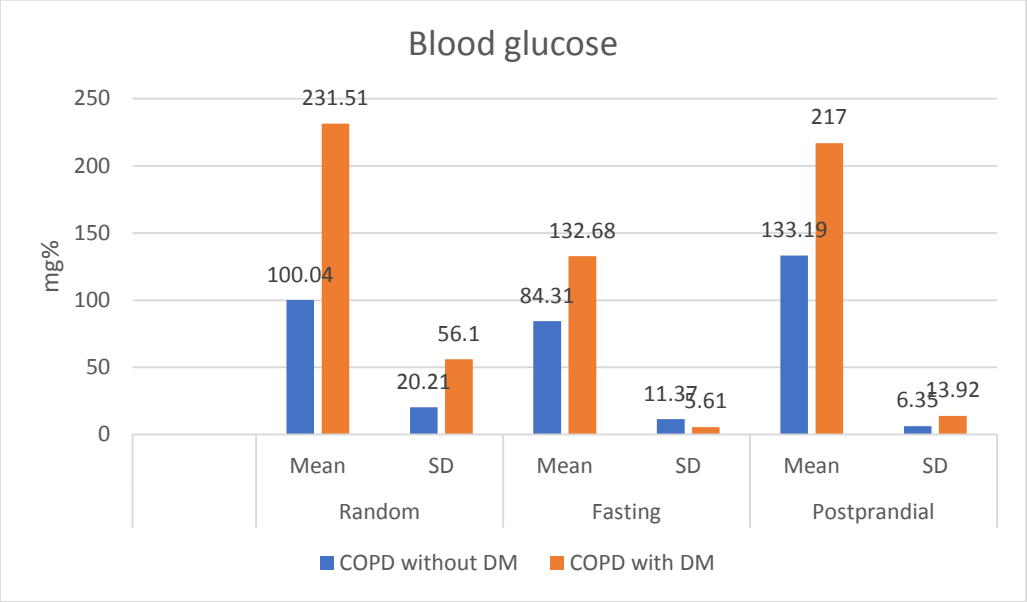

Table No.-11 HBA1C level wise distribution of study subjects

S. No.	Parameter	COPD without DM (Mean ± SD)	COPD with DM (Mean ± SD)
1.	HBA1C%	4.78 ± 0.45	8.47 ± 1.96

Table shows, HBA1C% level wise distribution of study subjects. Mean ± SD HBA1C% (4.78±0.45) and 8.47 ± 1.96) in both groups respectively.

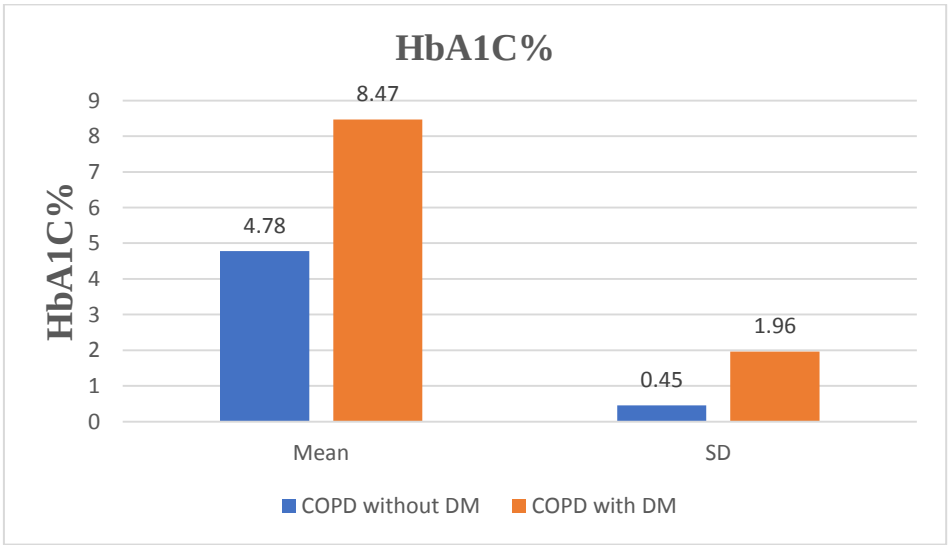

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Table No.-12 New cases versus known cases of DM

S. No.	Parameter	NO. of COPD with DM
1.	Newly diagnosed cases	8 (28%)
2.	Known cases	21 (72%)
	Total	**29**

Table shows, new cases versus known cases of DM. Out of 29, 8 cases were newly diagnosed at the time of admission without no previous history of DM and 21 patients were known cases of DM. Out of 100 COPD patients 8 (8%) patients were diagnosed DM at the time of admission.

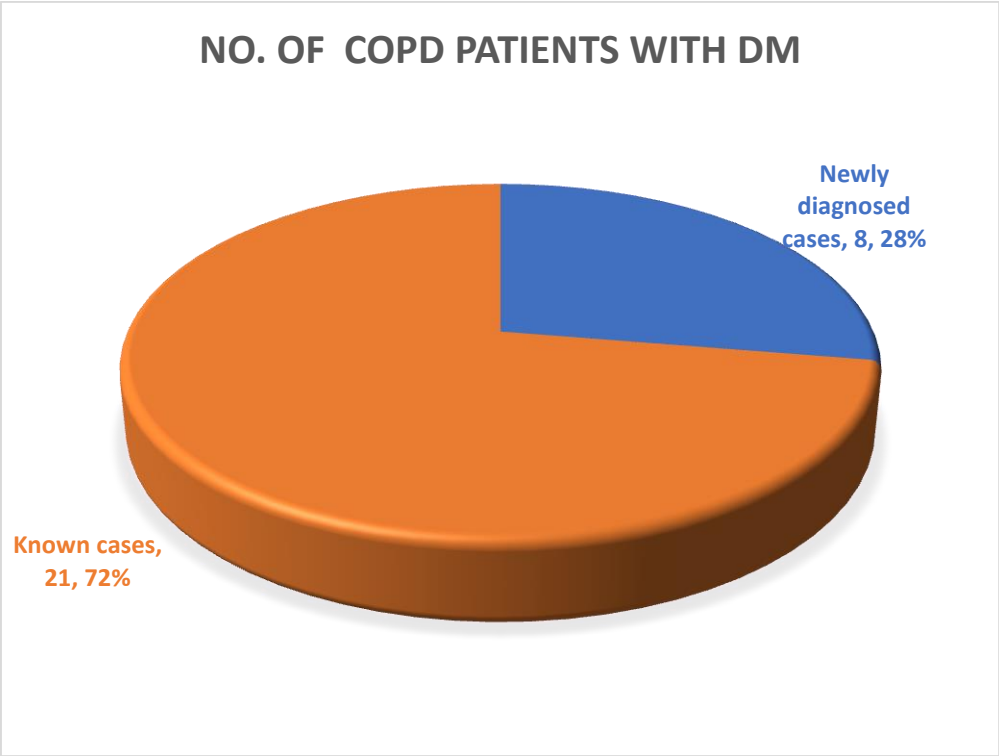

Table No.-13 COPD Duration wise distribution of study subjects

S. No.	Duration in years	COPD without DM	COPD with DM
1.	0-10 year	36 (50%)	10 (34%)
2.	11-20 year	31 (44%)	17 (59%)
3.	>20 year	4 (6%)	2 (7%)
	Mean Duration	12.85±5.09	14.51±4.59

Table depicts, COPD Duration wise distribution of study subjects in both groups. Majority of patients (50%) in COPD without DM group were in 0–10 years of duration group, followed by 44% patients in 11–20 years of duration group, 6% in >20 years of duration group. In COPD with DM group, majority of patients (59%) found in 11–20 years of duration group, followed by 34% patients in 0–10 years of duration group, 7% patients in >20 years of duration group.

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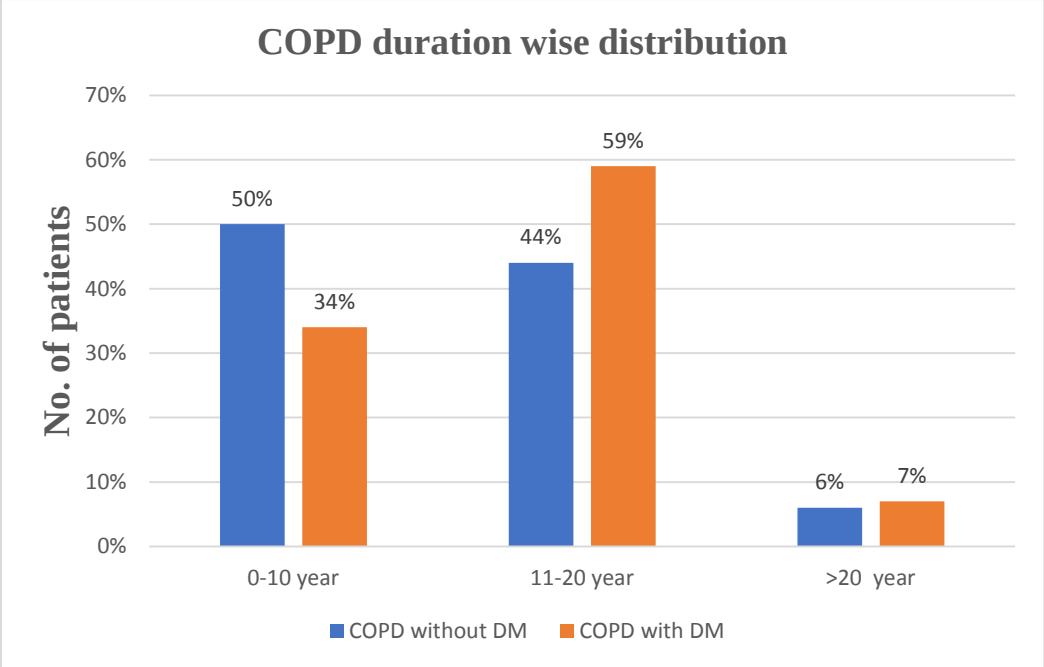

Table No.-14 mMRC wise distribution of study subjects

S. No.	mMRC grade	COPD without DM	COPD with DM
1.	0	0	0
2.	1	22 (31%)	4 (14%)
3.	2	31 (43.6%)	9 (31%)
4.	3	17 (24%)	14 ((48%)
5.	4	1 (1.4%)	2 (7%)

Table shows, mMRC wise distribution of study subjects. In COPD without DM group maximum patients (43.6%) found in mMRC grade-2, followed by 31% patients in mMRC grade-1, 24% patients in mMRC grade-3 and 1.4% patient in mMRC grade-1. In COPD with DM group majority of patients (48%) found in mMRC grade-3 followed by 31% patients in mMRC grade-2, 14% patients in mMRC grade-1 and 7% patients in grade-4.

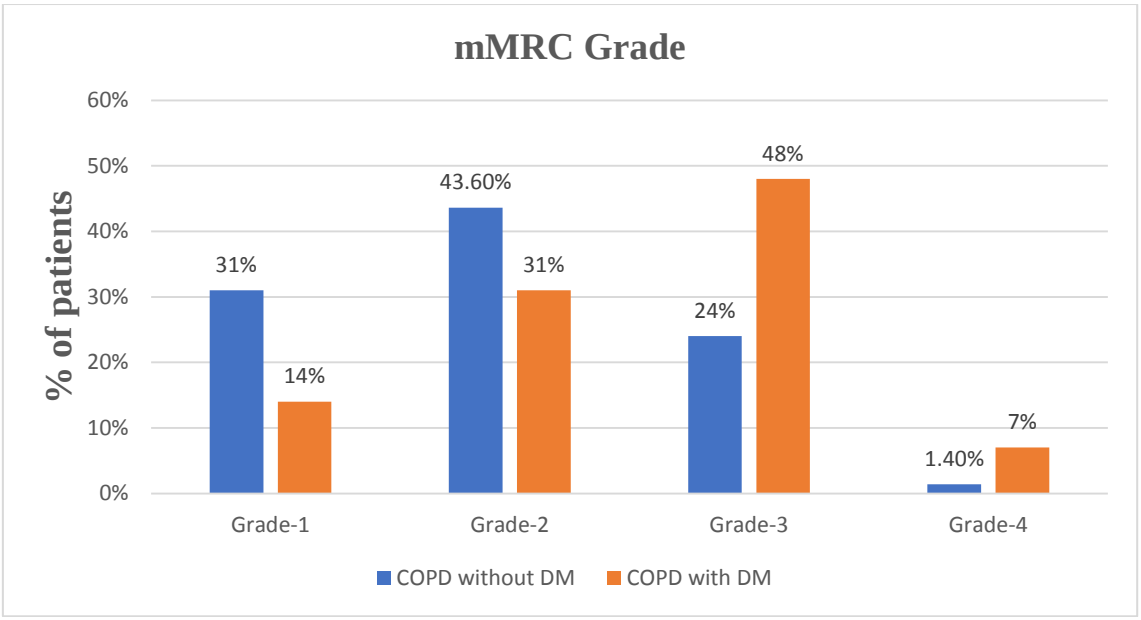

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Table No.-15 Admission per year wise distribution of study subjects

S. No.	Admission per Year	COPD without DM	COPD with DM	Unpaired t test P-value
1.	Mean	1.12	1.65	0.007
2.	SD	0.94	1.17	

Table shows, Admission per year wise distribution of study subjects. Mean ± SD (1.12±0.94) in COPD without DM group followed by (1.65±1.17) in COPD with DM group.p value (0.007) found significant.

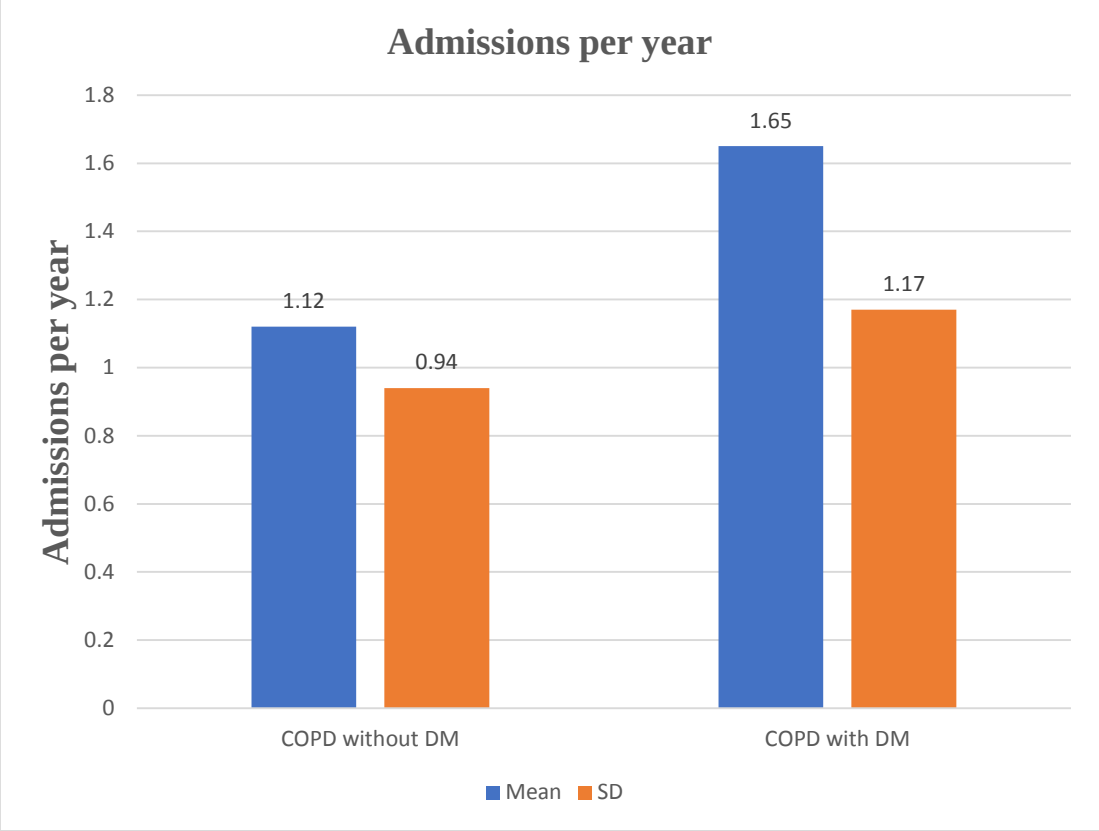

Table No.-16 Exacerbation per year wise distribution of study subjects

S. No.	Exacerbation per year	COPD without DM	COPD with DM	Unpaired t test P-value
1.	Mean	1.48	1.76	0.23
2.	SD	1.06	1.05	

Table shows, Admissions per year wise distribution of study subjects. Mean ± SD (1.48±1.06) in COPD without DM group followed by (1.76±1.05) in COPD with DM group.p value (0.23) found insignificant.

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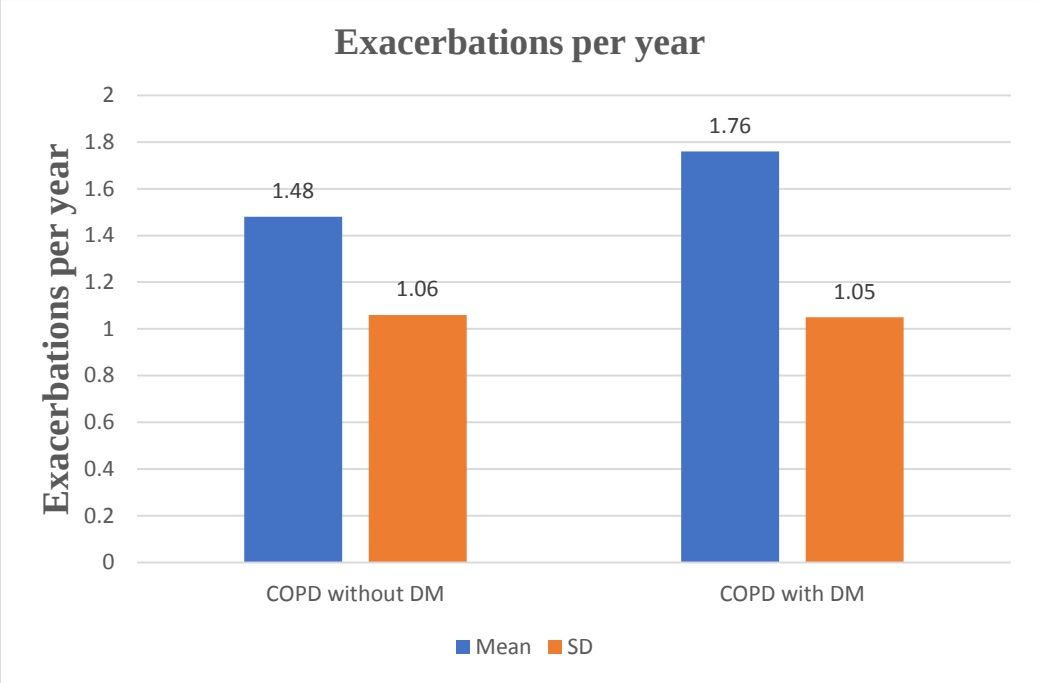

Table No.-17 Exacerbation wise distribution of study subjects

S. No.	Parameter	COPD without DM	COPD with DM	Unpaired t test P-value
1.	Presented with exacerbation	19 (27%)	11 (38%)	0.41
2.	Presented without exacerbation	52 (73%)	18 (62%)	

Table shows, Out of 71 patients, 19 (27%) cases Presented with exacerbation and 52 (52%) cases Presented without exacerbation in COPD without DM group and out of 29 cases,11 (38%) cases Presented with exacerbation and 18 (62%) cases presented without exacerbation in COPD with DM group. p value found statistically insignificant (<0.41).

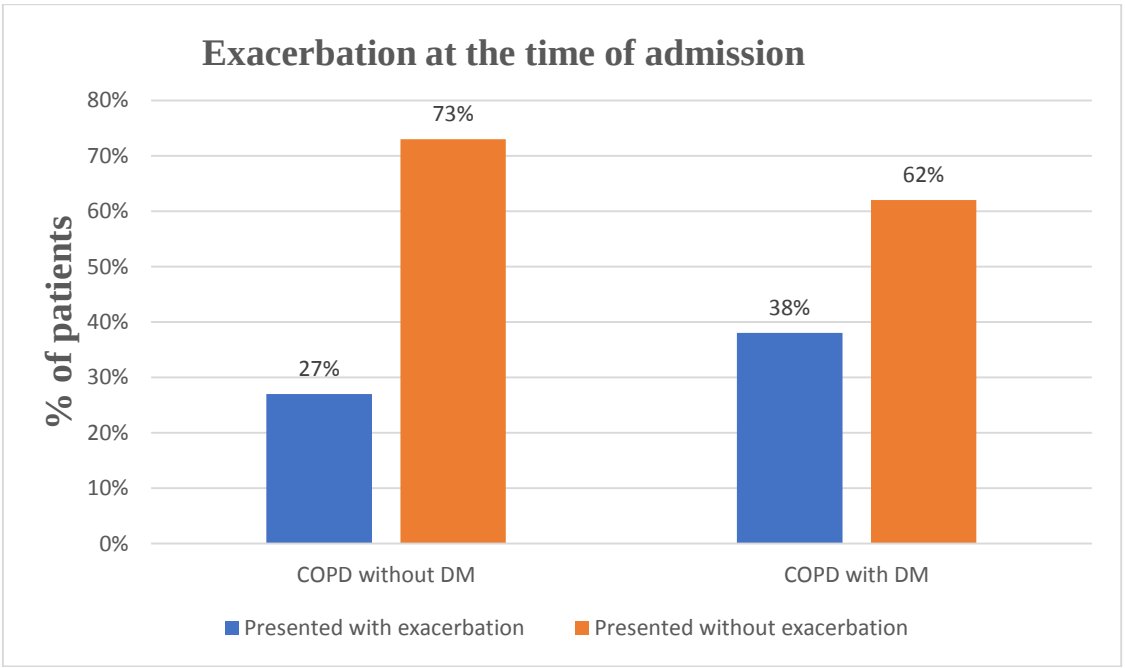

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Table No.-18 Six minutes walk distance wise distribution of study subjects

S. No.	Six minutes walk distance	COPD without DM	COPD with DM	Unpaired t test P-value
1.	≥350 meters	10 (14%)	3 (10%)	0.02
2.	250-349 meters	37 (53%)	10 (35%)	
3.	150-249 meters	18 (25%)	11 (38%)	
4.	≤149 meters	6 (8%)	5 (17%)	
	Mean distance	274±72	235±78	

Table depicts, Six minutes walk distance (6MWD) wise distribution of study subjects. In COPD without DM group maximum patients (53%) were in 250–349 meters of 6MWD category, followed by 25% patients in 150–249 meters of 6MWD, 14% patients in ≥ 350 meters of 6MWD, 8% patients were in ≤149 meters 6MWD category. In COPD with DM group, majority of patients, 38% found in 150–249 meters of 6MWD followed by 35% patients in 250–349 meters of 6MWD, 10% patients in ≥ 350 meters of 6MWD and 17% patients ≤149 meters of 6MWD category.

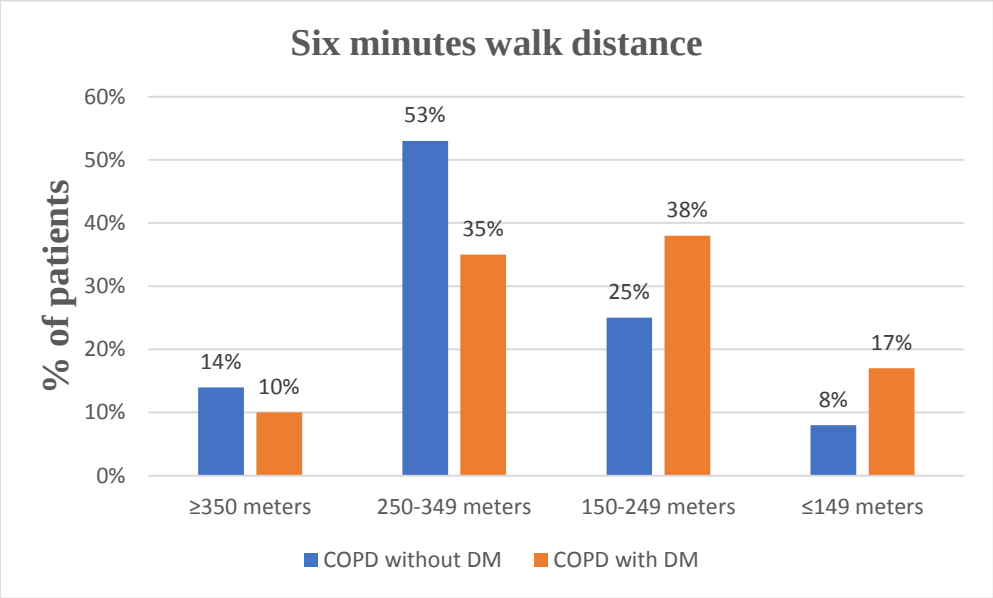

Table No.-19 BODE score wise distribution of study subjects

S. No.	BODE Score	COPD without DM	COPD with DM	Unpaired t test P-value
1.	≥7	11 (15%)	12 (42%)	0.004
2.	5-6	11 (15%)	6 (20%)	
3.	<5	49 (70%)	11 (38%)	
	Mean BODE score	3.50±2.25	5.20±2.69	

Table depicts, BODE score wise distribution of study subjects. Majority of patients (70%) in COPD without DM group and 38% patients in COPD with DM group had <5 BODE score followed by 15% patients in COPD without DM and 20% patients in COPD with DM group in 5–6 Bode Score range, 15% and 42% patients in both groups were found in ≥ 7 BODE score range, with the significant p value (0.004).

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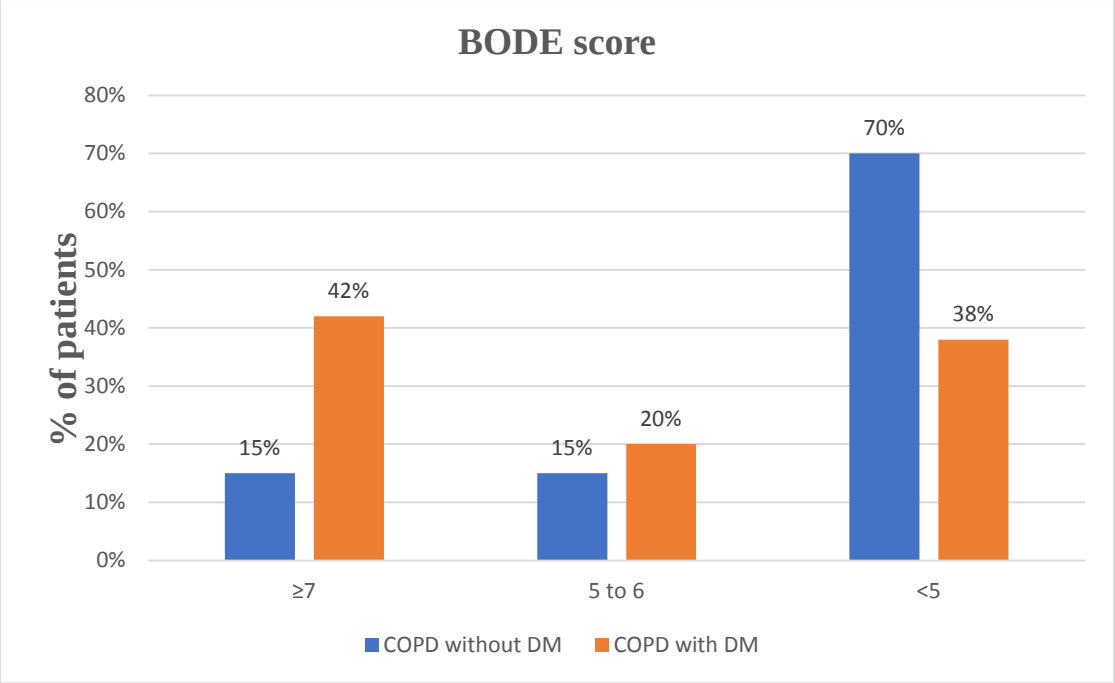

Table No.-20 CAT score wise distribution of study subjects

S. No.	CAT Score	COPD without DM	COPD with DM	Unpaired t test P-value
1.	<10	22 (31%)	5 (17%)	0.051
2.	≥10	49 (69%)	24 (83%)	
	Total	71	29	
	Mean CAT score	13.07±5.73	15.86±6.58	

Table depicts, CAT score wise distribution of study subjects. Majority of patients (71%) in COPD without DM and 83% patients in COPD with DM group had ≥10 CAT score followed by 31% patients in COPD without DM and 17% patients in COPD with DM group had ≤10 CAT score with the insignificant p value (0.051).

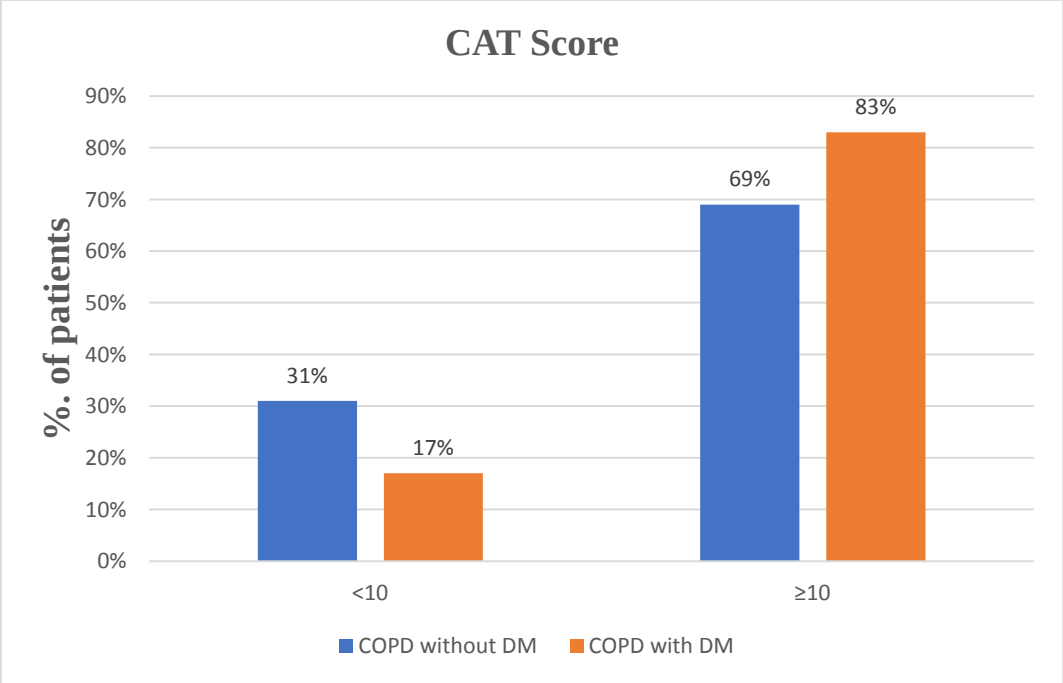

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Table No.-21 GOLD Grade (Spirometric severity) wise distribution of study subjects

S. No.	GOLD Grade	COPD without DM	COPD with DM
1.	GOLD-1	25 (35%)	4 (14%)
2.	GOLD-2	21 (30%)	6 (21%)
3.	GOLD-3	15 (21%)	10 (34%)
4.	GOLD-4	10 (14%)	9 (31%)

Table depicts, GOLD spirometric severity wise distribution of study subjects. In COPD without DM group maximum patients (35%) were found in GOLD grade-1, followed by 30% in GOLD grade-2, 21% patients in GOLD grade-3 and 14% patients in GOLD grade-4. In COPD with DM group majority of patients (34%) were found in GOLD grade-3 followed by 31% patients in GOLD grade-4, 21% patients were in GOLD grade-2 and 14% patients were in GOLD grade-1.

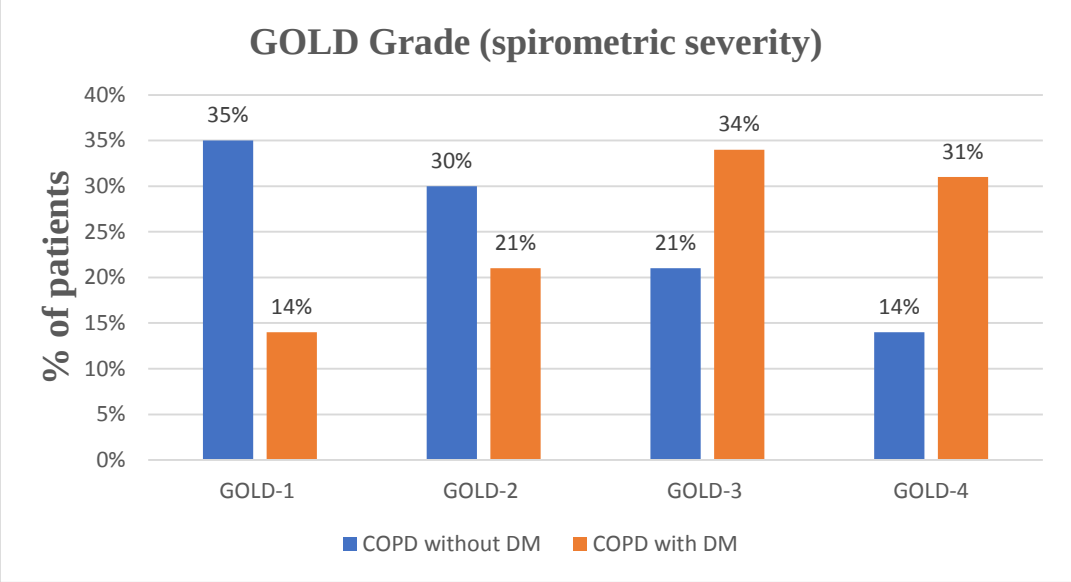

Table No.-22 GOLD Group wise distribution of study subjects

S .No.	GOLD Group	COPD without DM	COPD with DM
1.	A	9 (13%)	1 (3.4%)
2.	B	27 (38%)	2 (6.8%)
3.	C	13 (18%)	3 (10.2%)
4.	D	22 (31%)	23 (79.6%)

Table depicts, GOLD stage wise distribution of study subjects. Majority of patients 27(38%) in COPD without DM group were found in GOLD group B, followed by 22(31%) in GOLD group D, 13(18%) patients in GOLD group C and 9(13%) patients in GOLD group A. In COPD with DM group majority of patients 23(79.6%) found in GOLD group D, followed by 3(10.2%) patients in GOLD group C, 2(6.8%) patients were in GOLD group B and 1(3.4%) patient was in GOLD group A.

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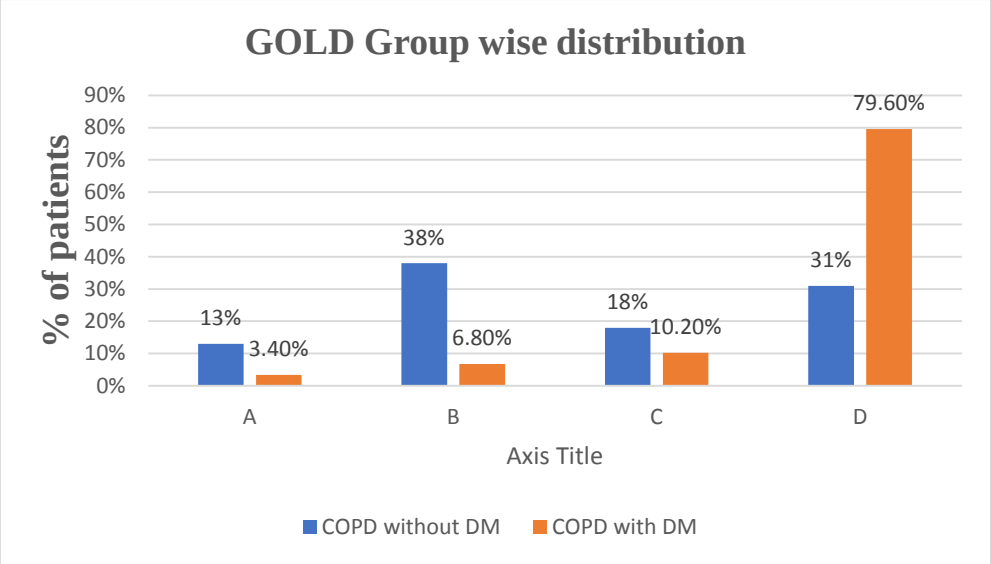

Table No.-23 Pulmonary function wise distribution of study subjects

S. No.	Parameters	COPD without DM	COPD with DM	Unpaired t test P-value
1.	FEV_1/FVC (%)	63.60 ± 7.30	58.80 ± 9.53	0.0191
2.	FEV_1 (L)	1.48 ± 0.58	1.03 ± 0.59	0.0009
3.	FEV_1 (% of predicted)	63.12 ± 23.86	45.37 ± 20.60	0.0004
.4.	PEFR (% of predicted)	42.88±17.20	29.51±19.24	0.0021
5.	FVC (L)	2.31 ± 0.85	1.72 ± 0.87	0.0035
6.	FVC (% of predicted)	74.52 ± 22.57	57.68 ± 23.49	0.0018

Table shows, Pulmonary functions wise distribution of study subjects. Mean ± SD of FEV1/FVC (%) (63.12 ± 23.86) and (45.37 ± 20.60) in both groups respectively, p value found significant (0.0191). In FEV_1 (L) Mean ± SD (1.48 ± 0.58) and (1.03 ± 0.59), p value found significant (0.0009). In FEV_1 (% of predicted) (63.12 ± 23.86) and (45.37 ± 20.60), p value found significant (0.0004). In PEFR (% of predicted) (42.88±17.20) and (29.51±19.24), p value found significant (0.0021). Mean ± SD (2.31±0.85) and (1.72 ± 0.87) in the parameter of FVC (L) p value was found significant (0.0035). In FVC (% of predicted) Mean ± SD (74.52 ± 22.57) and (57.68 ± 23.49), p value found significant (0.0018).

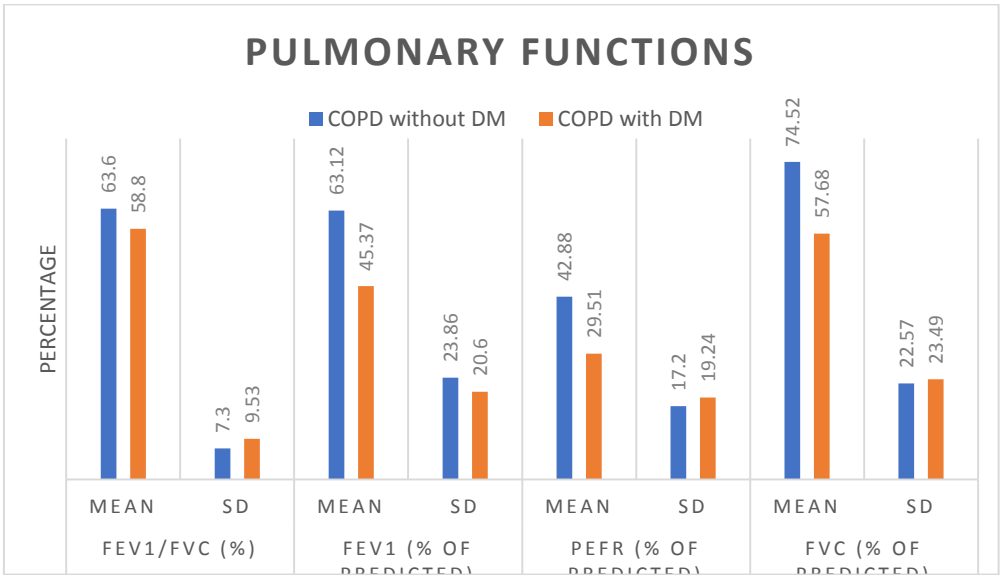

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Table No.-24 DM Duration and pulmonary function wise distribution of study subjects

S. No.	Duration (In Years)	NO. of COPD with DM	FEV1/FVC (%) Mean±SD	FEV1 (% of pred.) Mean±SD	PEFR (% of pred.) Mean±SD	FVC (% of pred.) Mean±SD
1.	0-5	15	64.43±3.52	58.53±19.98	39.66±21.43	72.93±21.52
2.	6-10	6	61.63±10.19	39.2±10.15	23.2±10.89	48±16.83
3.	>10	8	51.31±5.3	27±1.6	15.87±3.68	38±6.16
	ANOVA P-value		0.01	0.0002	0.01	0.0006

Table shows DM duration and pulmonary function in COPD with DM group .Out of 29 cases majority of cases 15 found in 0-5 years of duration of DM followed by 6 cases in 6-10 years of duration, 8 cases in >10 years of duration. Table shows as the duration of DM increase FEV1/FVC, FEV1, PEFR and FVC decrease.

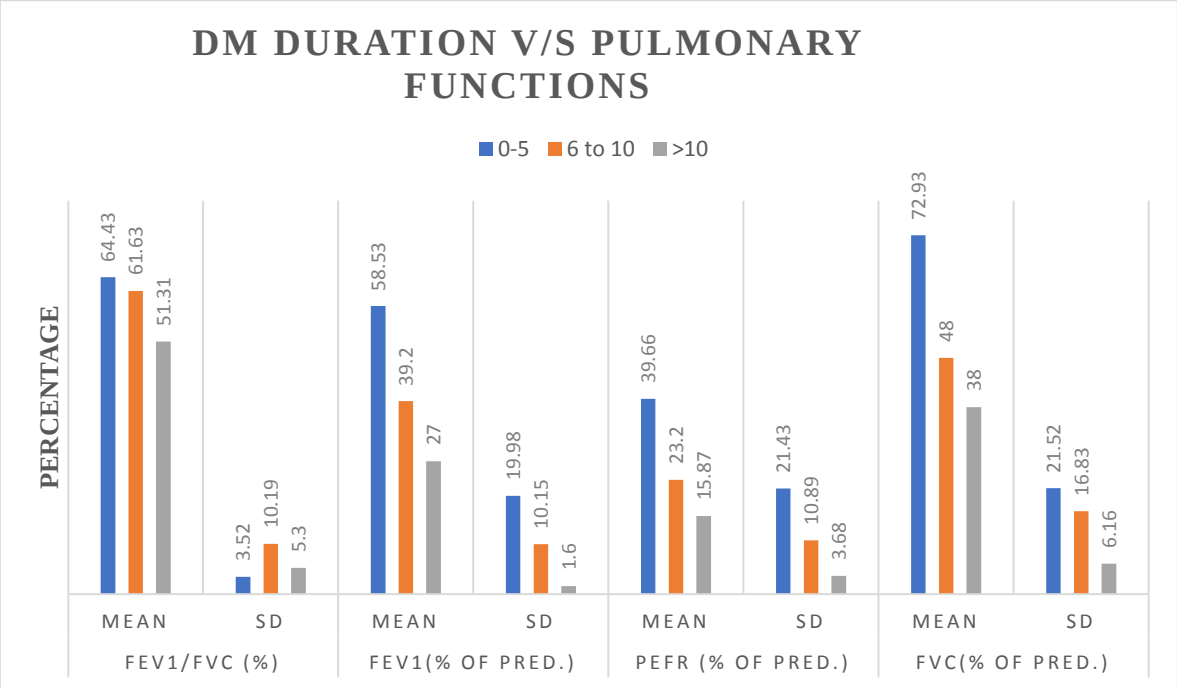

Table No.-25 Blood glucose level v/s pulmonary function wise distribution of study subjects

S. No.	Random Blood glucose (mg%)	No. of COPD patients with DM	FEV1/FVC % (Mean ± SD)	FEV1 (% of pred.) (Mean ± SD)	PEFR (% of pred.) (Mean ± SD)	FVC (% of pred.) (Mean ± SD)
1.	140-199	17	62.45±9.14	57.82±18.50	38.64±20.62	71.76±20.74
2.	200-300	8	55.03±9.17	28.87±1.45	17.87±3.04	39.25±7.28
3.	>300	4	50.83±2.90	25.5±0.57	14.0±3.36	34.75±1.89
	ANOVA P-value		0.01	0.0008	0.009	0.0002

Table shows, Random blood sugar and Pulmonary functions of COPD with DM study subjects. It shows as the Random blood glucose increases FEV1/FVC, FEV1, PEFR and FVC

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decrease.

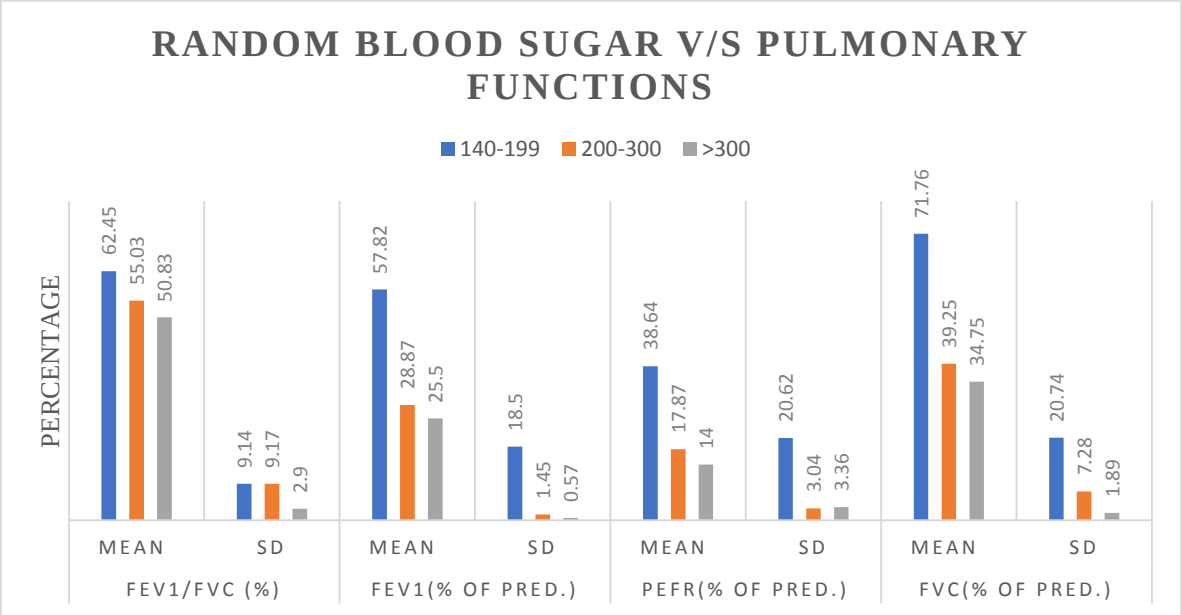
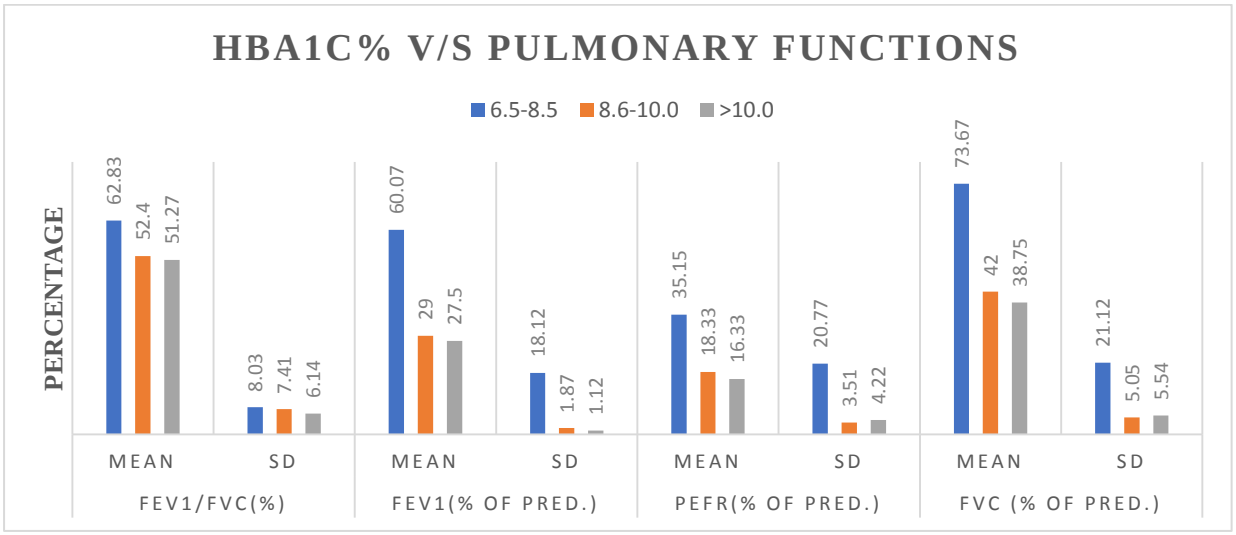


Table No.-26 HBA1C level v/s pulmonary function wise distribution of study subjects

S. No.	HBA1C%	No. of COPD Patients with DM	FEV1/FVC % (Mean ± SD)	FEV1 (% of pred.) (Mean ± SD)	PEFR (% of pred.) (Mean ± SD)	FVC (% of pred.) (Mean ± SD)
1.	6.5-8.5	20	62.83 ± 8.03	60.07 ± 18.12	35.15±20.77	73.67 ± 21.12
2.	8.6-10.0	3	52.40 ± 7.41	29.00 ± 1.87	18.33±3.51	42.00 ± 5.05
3.	>10.0	6	51.27 ± 6.14	27.50 ± 1.12	16.33±4.22	38.75 ± 5.54
	ANOVA P-value		0.0007	0.006	0.107	0.018

Table shows, HbA1C% and Pulmonary functions of COPD with DM group. It shows as the HbA1C% increases FEV1/FVC, FEV1, PEFR and FVC decrease.



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Discussion

The hospital based cross-sectionalstudy was conducted on patients attending Department of Respiratory Medicine, Sardar Patel Medical College, Bikaner, Rajasthan. The study included diagnosed patients of Chronic Obstructive Pulmonary disease, with or without type 2 DM, irrespective of severity and duration of the disease. Based upon inclusion and exclusion criteria a minimum of 100 cases were selected and grouped in COPD without DM and COPD with DM.

COPD represents a significant and growing health-care concern as a leading cause of morbidity and mortality worldwide. India contributes enormously to COPD burden which is estimated to be among the highest in the world. Mortality due to COPD in India is four fold greater than the USA and Europe. This number is expected to expand tremendously due to increasing exposure to tobacco smoking and biomass fuel. COPD is considered as a novel risk factor for new-onset type 2 DM due to chronic inflammation, oxidative stress, insulin resistance, weight gain, and dysfunction of fat metabolism.

On the other hand, the prevalence of DM is increasing rapidly worldwide. India is considered as the diabetes capital of the world with 41 million people having DM, and every fifth diabetic in the world is an Indian. Considering the significant change in the lifestyle, food habits, decreased physical activity, and obesity in the Indian population, there has been escalating epidemic of DM in both rural and urban Indian populations. With India currently experiencing a demographic shift with higher percentage of elderly population, the coexistence of these two chronic disorders in an individual is very high which would worsen the morbidity and mortality of the individual.

The present study showed that DM was found in 29% (29/100). Our findings are in line with other studies done previously. A study conducted in Belgaum, India in 2015 by **Mahishaleet al**[25] observed that the prevalence of DM in COPD patients was 25.63%. Another study conducted in, Davanagere, Karnataka, India in 2019 by **Ajit E et al**[26] observed that the prevalence of DM in COPD patients was 23.05%.

In our study maximum patients in both groups were found in 60-70 years age group. The mean age in COPD without DM group was 64.94±8.38 years and in COPD with DM group was 68.37±6.93years. Maximum patients in both groups were male. Our study was compatible with **Mahishale et al** who reported mean age of COPD without DM group 63.12±10.64 years and COPD with DM group 67.46±12.20 years and also reported maximum male patients in both groups. Silverman et al also concluded in their study that men have higher prevalence rates of COPD then women which has been attributed to the historically higher rates of smoking in men.

In our study maximum patients in both groups were from lower socio-economic class followed by middle class. Another study by **Malik et al**[27] support this finding.

BMI was lower in COPD without DM group (22.47±2.62) as compared to COPD with DM group (22.96±2.80). Loss of weight is most likely multifactorial in origin. Established explanation for weight loss in COPD include increased metabolic rate due to the increased energy cost of breathing as well as physical inactivity and malnutrition due to eating difficulties. **Landbo et al**[28] in 1999 in their study observed that COPD is associated with chronic weight loss and BMI is an independent predictor of mortality and also independent prognostic factor in COPD, a lower BMI (i.e. <21kg/$m^{2)}$ is associated with greater risk of death irrespective of the stage of the disease.

Smoking in the most important risk factor for COPD worldwide. In our study maximum patients in both groups were smoker. 77.46% in COPD without DM group and 79.31% in COPD with DM group were smoker or ex-smoker. The mean pack/year in COPD without DM group 27.81±7.69 and in COPD with DM group 29.13±6.75.

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Another risk factor for COPD specially in women is biomass fuel exposure. In our study 14 women out of 19 in COPD without DM group and 6 out of 9 in COPD with DM group were exposed to biomass fuel. Mean biomass fuel exposure in COPD with DM group were 25.00±5.54 years while in COPD with DM group were 27.00±4.47 years.

All patients in both groups were presented with breathlessness, 68 patients out of 71 in COPD without DM group and 27 out of 29 in COPD with DM group were presented with cough. 46 patients in COPD without DM group and 17 in DM group were presented with expectoration. 64 patients in COPD without DM group and 26 in DM group were presented with wheezing. 27 patients in COPD without DM group and 13 in DM group were presented with chest pain.

In our study in COPD without DM group mean Random blood sugar was 100.04±20.21, Fasting blood sugar 84.31±11.37, Post prandial blood sugar 133.19±6.35, HBA1C% 4.78±0.45 while in COPD with DM group mean Random blood sugar was 231.51±56.10, Fasting blood sugar 132.68±5.61, Post prandial blood sugar 217.0±13.92, HBA1C% 8.47±1.96.

In our study out of 100 COPD patients 8 (8.0%) were newly diagnosed DM at the time of admission. It was supported by a study conducted by **Ajit E et al** which showed that a significant number of diabetics 35 out of 412 total COPD patients (8.49%) were newly detected. They were not aware of their diabetic status. It is proved beyond doubt that COPD is a condition which predisposes to develop new-onset type 2 DM.

In our study duration of COPD in without DM group was 12.85±5.09 years while in DM group was 14.51±4.59 years. Study conducted by **Mahishale et al** reported mean duration of COPD without DM group 6.83±3.26 years and COPD with DM group 7.82±2.3 years. Another study conducted by **Ajit E et al** reported mean duration of COPD without DM group 6.42±1.98 years and COPD with DM group 7.02±2.10 years.

In our study maximum patients (43.6%) in COPD without DM group were presented with grade-2 mMRCdyspnea while in COPD with DM group maximum patients (48%) presented with grade-3 mMRCdyspnea.

In our study in COPD without DM group admissions per year were 1.12±0.94 while in COPD with DM group were 1.65±1.17 which was found statistically significant. Exacerbations per year in COPD without DM group were 1.48±1.06 while in COPD with DM group were 1.76±1.05. In our study 19 patients out of 71 (26.76%) in COPD without DM group were presented with exacerbation while 11 out of 29 (37.93%) in COPD with DM group were in exacerbation at the time of admission. It was compatible with study conducted by **Ajit E et al** where 16.71% in COPD without DM group and 29.47% in COPD with DM group were presented with exacerbation.

The mean six minutes walk distance in COPD without DM group was 274±72 meters while in COPD with DM group was 235±78 meters which was found statistically significant. BODE index was 3.50±2.25 in COPD without DM group and 5.20±2.69 in COPD with DM group and it was statistically significant. Our study was supported by study conducted by **AbhijitKunduet al**[29] in 2015. The mean CAT score was 13.07±5.73 in COPD without DM group while in COPD with DM group was 15.86±6.58. A study conducted by **Hassan Ghobadiet al**[30] in 2012 was compatible with our study.

In our study maximum patients were in GOLD grade-1 in COPD without DM group and in GOLD grade-3 in COPD with DM group. In COPD without DM group out of 71 patients, 25 (35.21%) were in mild, 21 (29.57%) in moderate, 15 (21.12%) in severe and 10 (14.08%) in very severe stage of COPD. In DM group out of 29 patients, 4 (13.79%) were in mild, 6 (20.68%) in moderate, 10 (34.48%) in severe and 9 (31.03%) in very severe stage of COPD. Our results supported by study done by **Ajit E et al** who reported that in COPD with DM group 14.73% patients were in mild stage, 18.94% in moderate, 36.84% in severe and 19.66% patients were in very severe stage.

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In our study in COPD without DM group out of 71 patients, 9 (12.67%) were in GOLD group A, 27 (38.02%) in GOLD group B, 13 (18.30%) in GOLD group C and 22 (30.98%) were in GOLD group D. In COPD with DM group out of 29 patients, 1 (3.44%) was in GOLD group A, 2 (6.89%) in GOLD group B, 3 (10.34%) in GOLD group C and 23 (79.31%) were in GOLD group D.

In our study in COPD without DM group mean FEV1/FVC (%) was 63.60±7.30 while in COPD with DM group was 58.80±9.53 which was significant (p value 0.0191). In COPD without DM group mean FEV1 (L) was 1.48±0.58 and in COPD with DM group was 1.03±0.59 which was significant (p value 0.0009). In COPD without DM group mean FEV1 (% of predicted) was 63.12±23.86 and in COPD with DM group was 45.37±20.60, which was found significant (p value 0.0004). In COPD without DM group mean PEFR (% of predicted) was 42.88±17.20 and in COPD with DM group was 29.51±19.24, which was found significant (p value 0.0021). In COPD without DM group mean FVC (L) was 2.31±0.85 and in DM group was 1.72±0.87 which was statistically significant (p value 0.0035). In COPD without DM group mean FVC (% of predicted) was 74.52±22.57 while in COPD with DM group was 57.68±23.49 which was found significant (p value 0.0018). Our study was compatible with various other studies. A study conducted by **El-Habashy et al**[31]in 2014 showed that mean FEV1/FVC(%), FEV1, PEFR and FVC were low in diabetics (p value <0.05) .**Mahishale et al** in 2015 reported that Of the 490 subjects analyzed, 336 (68.57%) had Poor Glycemic Control (PGC) and 154 (31.43%) had Optimal Glycemic Control (OGC). COPD patients with PGC had more severe disease compared to OGC (Mean FEV1% predicted 48.47 ± 13.7 vs 67.4 ± 13.86, p= 0.0061). A study conducted by **SupriyaAdiody et al**[32] in 2017 showed that presence of DM worsens the lung functions including FVC, FEV1, FEV 25- 75 and PEF and pushes the COPD patients to the next severity stage. **Ajit E et al** in 2019 reported that there was a severe decline in lung function (mean FEV1 – 45.92 ± 4.22) in people with diabetes as compared to nondiabetics (56.64 ± 3.58) and it was found to be statistically significant (P = 0.001). Acute exacerbations were seen more in diabetics than nondiabetics with a significant difference (P = 0.008).

The present study showed that in COPD with DM group if duration of DM was 0-5 years, the mean FEV1/FVC (%) 64.43±3.52, FEV1 (% of predicted) 58.53±19.98, PEFR (% of predicted) 39.66±21.43 and FVC (% of predicted) was 72.93±21.52. If duration of DM was 6-10 years, the mean FEV1/FVC (%) 61.63±10.19, FEV1 (% of predicted) 39.2±10.15, , PEFR (% of predicted) 23.2±10.89 and mean FVC (% of predicted) was 48±16.83 . If duration of DM was >10 years, the mean FEV1/FVC (%) 51.31±5.3, FEV1 (% of predicted) 27±1.6, PEFR (% of predicted) 15.87±3.68 and mean FVC (% of predicted) was 38±6.16. Study shows that as the duration of DM increases pulmonary functions decrease. Our study was compatible with another study conducted by **Matsubara & Hara et al**[33]

The present study showed that in COPD with DM group if the Random blood sugar was 140-199 mg%, the mean FEV1/FVC (%) was 62.45±9.14, FEV1 (% of predicted) 57.82±18.50, , PEFR (% of predicted) 38.64±20.62 and the mean FVC (% of predicted) was 71.76±20.74. If the Random blood sugar was 200-300 mg%, the mean FEV1/FVC (%) was 55.03±9.17, FEV1 (% of predicted) 28.87±1.45, , PEFR (% of predicted) 17.87±3.04 and mean FVC (% of predicted) was 39.25±7.28. If the Random blood sugar was >300 mg%, , the mean FEV1/FVC (%) was 50.83±2.90, FEV1 (% of predicted) 25.5±0.57, , PEFR (% of predicted) 14.0±3.36 and mean FVC (% of predicted) was 34.75±1.89. Study shows that as the Random blood sugar increases pulmonary functions decrease. Our study was supported by another study conducted by **Makkar P et al** [34]

Our study showed that in COPD with DM group if the HBA1C% was 6.5-8.5, the mean FEV1/FVC (%) was 62.83±8.03, FEV1 (% of predicted) 60.07±18.12, , PEFR (% of predicted) 35.15±20.77 and the mean FVC (% of predicted) was 73.67±21.12. If the

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HBA1C% was 8.6-10.0, the mean FEV1/FVC (%) was 52.40±7.41, FEV1 (% of predicted) 29.00±1.87, , PEFR (% of predicted) 18.33±3.51 and the mean FVC (% of predicted) was 42.00±5.05. If the HBA1C% was >10, the mean FEV1/FVC (%) was 51.27±6.14, FEV1 (% of predicted) 27.50±1.12, , PEFR (% of predicted) 16.33±4.22 and the mean FVC (% of predicted) was 38.75±5.54. Study shows that as the HBA1C% increases pulmonary functions decrease. Our study was compatible with another study conducted by **Mori et al** [35]

Conclusion

DM is a common comorbidity seen in patients with COPD. Majority of these patients have poor glycemic control, which severely affects the clinical course of COPD. Patients with poor glycemiccontrol had more severe COPD, poor lung function, high symptom score, and increased risk of exacerbations with frequent and prolonged hospitalizations. Hence it is imperative to screen all COPD patients for DM. Achieving optimal glycemic control in these patients should be the priority at all the levels of health care services to avert negative impact of poorglycemic control on COPD patients. As pulmonary dysfunction may be one of the earliest and early measurable non metabolic alterations in DM, patients with DM are suggested to undergo PFT along with other investigations. It is advisable therefore, that diabetic patients must undergo periodic spirometry tests to assess the severity of lung function impairment. These measures will help in preventing lung damage in initial stage and thus contribute to reduction in morbidity and mortality of these patients.

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